

What is claimed is:

1. A method of forming MgB<sub>2</sub> films *in-situ* on a substrate comprising the steps:

5 (a) depositing boron onto a surface of the substrate in a deposition zone;

(b) moving the substrate into a reaction zone containing pressurized gaseous magnesium;

(c) moving the substrate back into the deposition zone;

10 and

(d) repeating steps (a) - (c) .

2. The method of claim 1, wherein the movement of steps

(b) and (c) is produced by rotating the substrate on a platen.

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3. The method of claim 2, wherein the platen is rotated at a rate within the range of about 100 rpm to about 500 rpm.

4. The method of claim 1, wherein the substrate is

20 heated to a temperature within the range of about 300°C to about 700°C.

5. The method according to claim 1, wherein the substrate is selected from the group consisting of LSAT, LaAlO<sub>3</sub>, MgO,

SrTiO<sub>3</sub>, r-plane sapphire, c-plane sapphire, m-plane sapphire, yttria-stabilized zirconia (YSZ), silicon carbide, polycrystalline alumina, silicon, and stainless steel.

5 6. A MgB<sub>2</sub> film produced by the method of claim 1.

7. The method according to claim 1, wherein the reaction zone is coupled to a heated source of magnesium.

10 8. The method according to claim 1, wherein the substrate is a wafer.

9. The method according to claim 1, wherein the substrate is a tape.

15 10. The method according to claim 1, wherein the method is used to form MgB<sub>2</sub> on a plurality of substrates.

11. The method of claim 1, wherein the film of MgB<sub>2</sub> is 20 generated under a pressure of less than 10<sup>-6</sup> Torr in the deposition zone.

12. The method of claim 1, wherein the MgB<sub>2</sub> film is formed on a single side of the substrate.

13. The method of claim 1, wherein the MgB<sub>2</sub> film is formed on two sides of the substrate.

5 14. A method of forming a film of MgB<sub>2</sub> *in-situ* comprising the steps of:

providing a rotatable platen, the platen being rotatable within a housing having a reaction zone and a separate deposition zone;

10 providing an evaporation cell operatively coupled to the reaction zone, the evaporation cell containing magnesium;

providing a source of boron disposed adjacent to the deposition zone;

15 providing an electron beam gun aimed at the source of boron;

loading a substrate onto the platen;

rotating the platen;

heating the local environment around the substrate;

heating the evaporation cell so as to produce gaseous 20 magnesium in the reaction zone; and

evaporating the boron with the electron beam gun.

15. The method according to claim 14, wherein the local environment around the substrate is heated to a temperature within the range of about 300°C to about 700°C.

5 16. The method according to claim 14, wherein the evaporation cell is heated to a temperature of at least 550°C.

17. The method according to claim 14, wherein the platen is rotated at a rate within the range of about 100 rpm to about 10 500 rpm.

18. The method according to claim 14, wherein the substrate is selected from the group consisting of LSAT, LaAlO<sub>3</sub>, MgO, SrTiO<sub>3</sub>, r-plane sapphire, c-plane sapphire, m-plane sapphire, yttria-stabilized zirconia (YSZ), silicon carbide, polycrystalline alumina, silicon, and stainless steel.

19. The method of claim 14, wherein the substrate is a wafer.

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20. The method of claim 14, wherein the substrate is a tape.

21. The method of claim 14, wherein the step of loading the platen comprises loading the platen with a plurality of substrates.

5 22. The method of claim 14, wherein the film of MgB<sub>2</sub> is generated under a pressure of less than 10<sup>-6</sup> Torr in the deposition zone.

10 23. The method of claim 14, wherein a film of MgB<sub>2</sub> is formed on a single side of the substrate.

15 24. The method of claim 14, further comprising the steps of removing the substrate from the platen; turning the substrate over; loading the substrate onto the platen; rotating the platen; heating the local environment around the substrate; heating the evaporation cell so as to produce pressurized gaseous magnesium in the reaction zone; and 20 evaporating the boron with the electron beam gun.

25. A MgB<sub>2</sub> film produced by the method of claim 14.

26. A method of forming a superconducting film of a known superconducting compound *in-situ* on a substrate comprising the steps:

- (a) depositing one or more elements of the superconductor onto a surface of the substrate in a deposition zone;
- 5 (b) heating a non-gaseous element of the superconductor so as to produce a pressurized gaseous phase of the element inside a reaction zone;
- (c) moving the substrate into the reaction zone containing the pressurized gaseous element;
- 10 (d) moving the substrate back into the deposition zone;
- (e) repeating steps (a) - (d) .

and

15 27. The method of claim 26, wherein the superconducting film is a superconductor selected from the group consisting of magnesium diboride, YBCO, BSCCO, TBCCO, and HBCCO.

28. A method of forming a film of a known compound *in-situ* 20 on a substrate comprising the steps:

- (a) depositing one or more elements of the compound onto a surface of the substrate in a deposition zone;

(b) heating a non-gaseous element of the compound so as to produce a pressurized gaseous phase of the element inside a reaction zone;

(c) moving the substrate into the reaction zone containing 5 the pressurized gaseous element;

(d) moving the substrate back into the deposition zone;

and

(e) repeating steps (a) - (d) .

10 29. The method of claim 28, wherein the compound is a superconductor.